Microsoft

Analytics in a Day
Azure Synapse + Power BI better together

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Module aim

- This module aims to empower data architects and BI developers with the technical knowledge required to design an enterprise BI solution that leverages **Azure Synapse Analytics** and **Power BI**

Sections

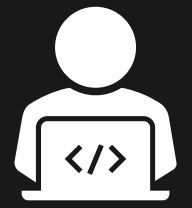
01: Microsoft BI Solution Architecture

02: Deliver Discipline at the Core

03: Deliver Flexibility at the Edge

04: Author Power BI Reports (Optional)

Exercises



Exercise 05: Develop a Power BI Model 45 minutes

Exercise 06: Optimize the Power BI Model 15 minutes

Exercise 07: Create a Model Using DQ to Power BI 20 minutes

Exercise 08: Author a Power BI Report (Optional) 45 minutes

Exercises

Scenario

- The exercises are based on the sales of the fictitious Wide World Importers company
- The Wide World Importers company:
  - Has a cloud data warehouse using Azure Synapse Analytics
  - Needs to explore and discover insight from their data
- In the exercises:
  - *As a data architect or BI developer*, you will develop, optimize, and publish a Power BI model
  - *As a data analyst*, you will create a model using DQ to Power BI, and author and publish a Power BI report

Exercises

Getting setup

- You will develop a Power BI model that connects to the Azure Synapse Analytics data warehouse
  - You must use the lab Azure credentials to connect to Azure Synapse and publish to Power BI

Questions?

Microsoft

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Section 01

Microsoft BI Solution Architecture

Section outline

01: Microsoft BI Solution Methodology

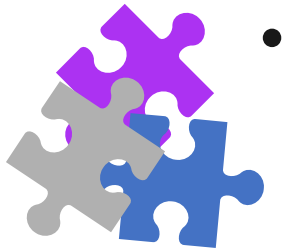
- Microsoft’s BI transformation
- Center of Excellence

Microsoft’s BI transformation

- The revolution in Microsoft’s own BI tools has changed how the company itself explores and uses its own data
- Like many companies coming to grips with data technology, it encouraged a culture where individuals pursued full ownership of data and insights
- It also experienced strong cultural resistance to doing things in a standardized way

Microsoft's BI transformation

Challenges



- The organization culture at Microsoft led to many reporting and analytic challenges:
  - Inconsistent data definitions, hierarchies, metrics, KPIs
  - Analysts spending 75% of their time collection and compiling data
  - 78% of reports being created in "offline environments"
  - Over 350 centralized finance tools and systems
  - Approximately $30M annual spend on "shadow applications"
- These challenges prompted the business to consider how they could do things better

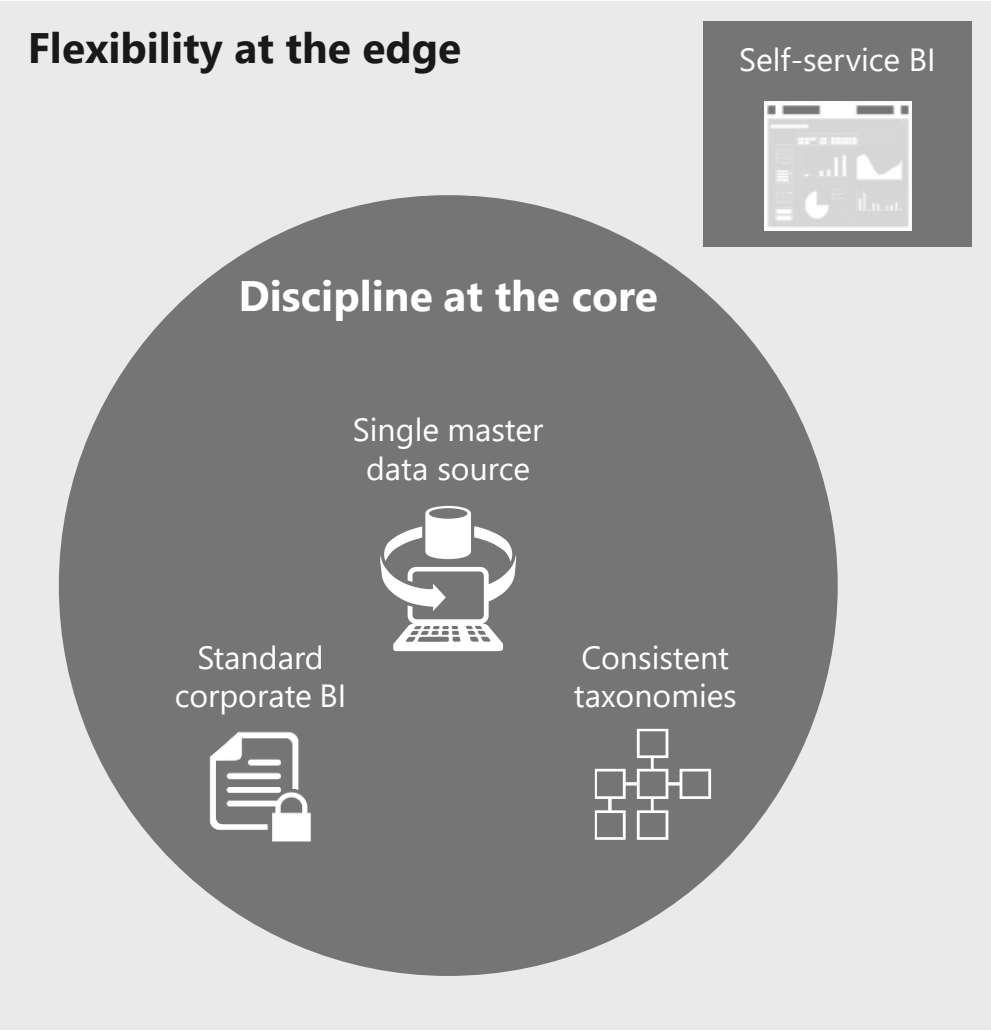
Microsoft's BI transformation

Solution

- Today, Microsoft has a data-driven culture with Business Intelligence for all
- It has achieved success by designing a BI solution methodology
- The methodology is responsible for transforming its business to one with:
  - ✓ Centralized BI managed by IT
  - ✓ Extended with self-service BI
- Microsoft describes it in two creative ways:
  - ✓ Discipline at the core
  - ✓ Flexibility at the edge

Microsoft's BI transformation

Solution



- **Discipline at the core**
  - IT retains control by curating a single master data source to:
    - Deliver standardized corporate BI
    - Define consistent taxonomies, hierarchies, and KPIs
    - Enforce data permissions centrally
- **Flexibility at the edge**
  - Analysts can analyze data more quickly to:
    - Quickly create reports sourced from trusted data
    - Mashup core data with departmental data
    - Create new metrics and KPIs relevant to their part of the business

Microsoft's BI transformation

Unified platform

- The Microsoft BI solution methodology has resulted in a unified data and analytics platform, supporting all areas of the business
- Today, the platform:
  - Powers all scorecards, reports and analytics
  - Supports self-service analytics
  - Drives planning processes
  - Delivers automatic and dynamic reporting and analytics from a single source of truth
- It is a very successful story, and Microsoft likes to share their BI solution methodology with their customers

Center of Excellence

- To help you setup *Discipline at the Core* and *Flexibility at the Edge*, we recommend you establish a **Center of Excellence** (COE)
- A COE is a central team responsible for defining company-wide metrics and definitions
  - Also, it can include change initiatives, standard processes, roles, guidelines, best practices, support, training, and more
- It is also a business function that organizes people, processes, and technology components into a comprehensive set of business competencies and capabilities
- The overriding goal of the COE is to deliver value and maximize business success

Resources

Power BI Center of Excellence

https://docs.microsoft.com/power-bi/guidance/center-of-excellence-establish

Power BI Adoption Framework

Provides a set of guidance, practices, and resources to help organizations build a data culture, establish a Power BI Center of Excellence, and manage Power BI at any scale

PPTX: https://github.com/pbiaf/powerbiadoption

YouTube: https://www.youtube.com/playlist?list=PL1N57mwBHtN0UZbEgLHtA1yxqPlae3B90

Questions?

Microsoft

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Section 02

Deliver Discipline at the Core

Section outline

02: Deliver Discipline at the Core

- Why Power BI data models?
- Power BI data modeling
- Developing models

Why Power BI data models?

- **Power BI** models are the way to effectively connect decision makers with the data warehouse
  - Semantic layer, providing intuitive browsing and exploration
  - Deliver high performance (with the assistance of cached aggregations)
  - Encapsulate complex calculation logic
  - Source for rich interactive reports, and dashboards

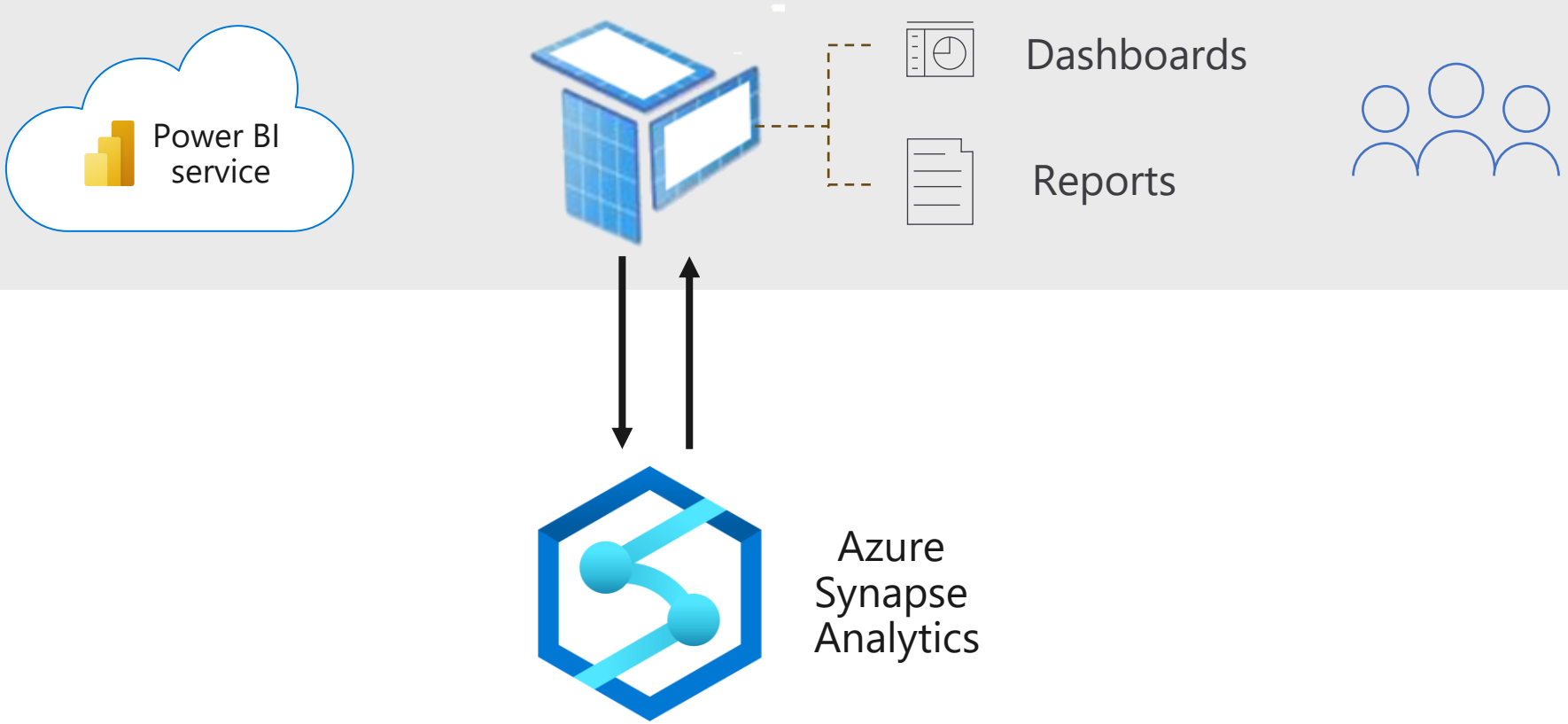
Why Power BI data models?

- Power BI data models can scale to query large data stores, such as a data warehouse
- Typically, these models:
  - Are designed and developed by BI developers
  - Represent large data volumes
  - Support high report user concurrency
- Consideration must be given to the Power BI capacity that will host the model

Capacities are introduced later in this section

Why Power BI data models?

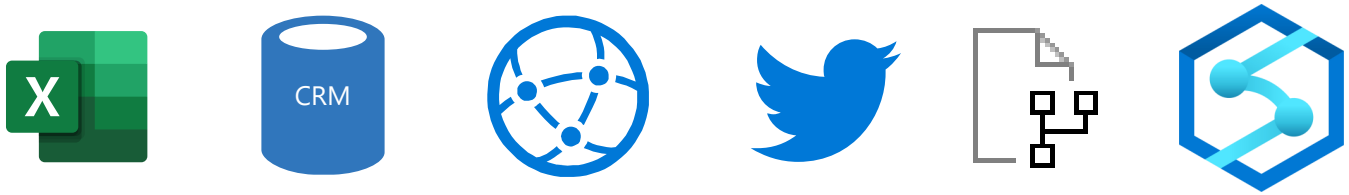
Architecture



Power BI data modeling

Model basics

- Power BI is built upon the mature foundations of Analysis Services
  - Specifically, it is based on tabular modeling technologies
- Models can source data from practically any data source
  - Cloud or on-premises
  - File, database, web page, or SaaS provider



- When published to Power BI, a model is known as a *dataset*

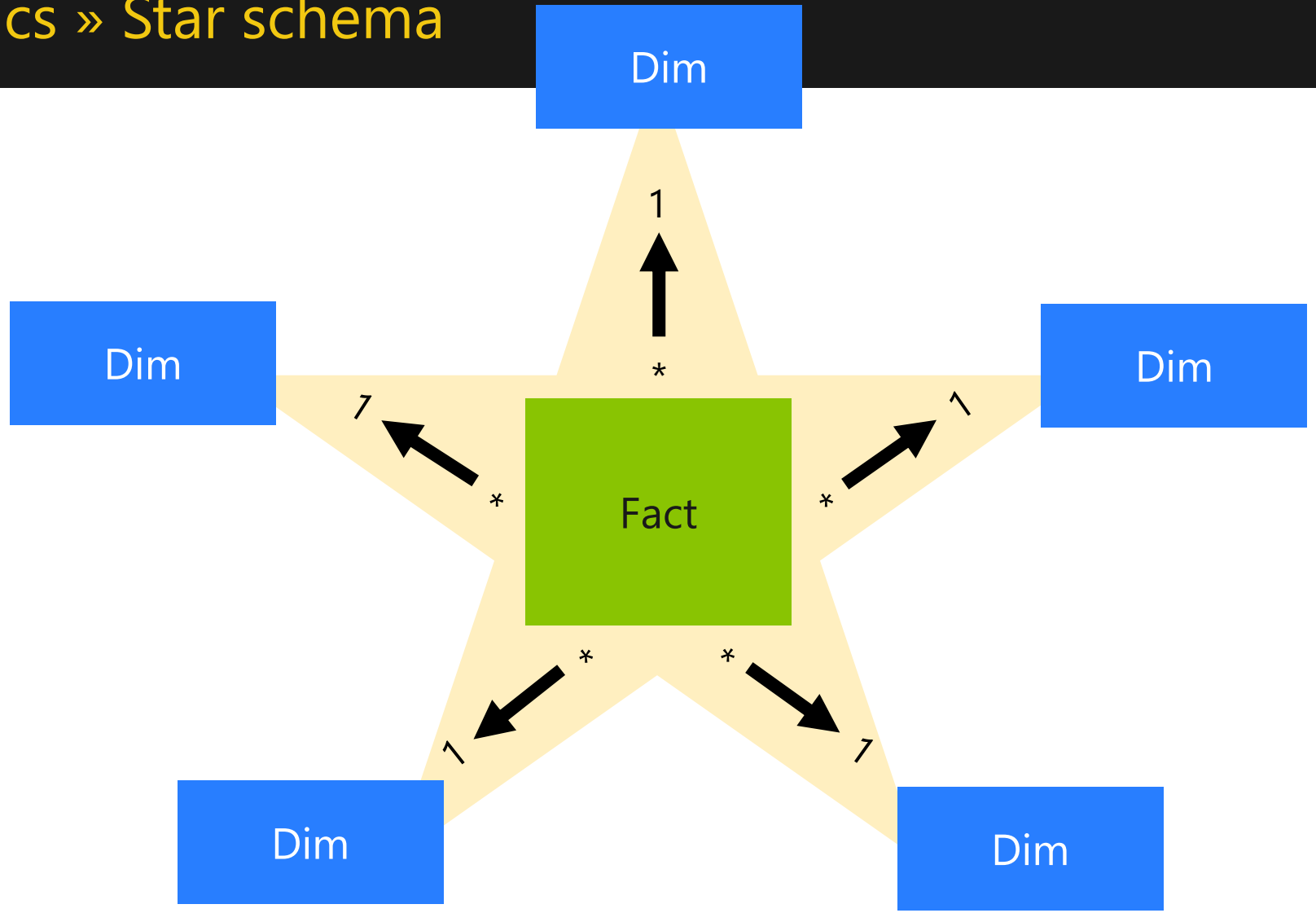
Power BI data modeling

Model basics

- Models have tables, and tables have columns
- Table are related for purposes of filter propagation
- Often, dimensional modeling (star schema) is the optimal design approach for Power BI models
  - **Dimension tables** define business entities
  - **Fact tables** define business activity or observations
- A star schema can comprise multiple stars, each based on a single fact table

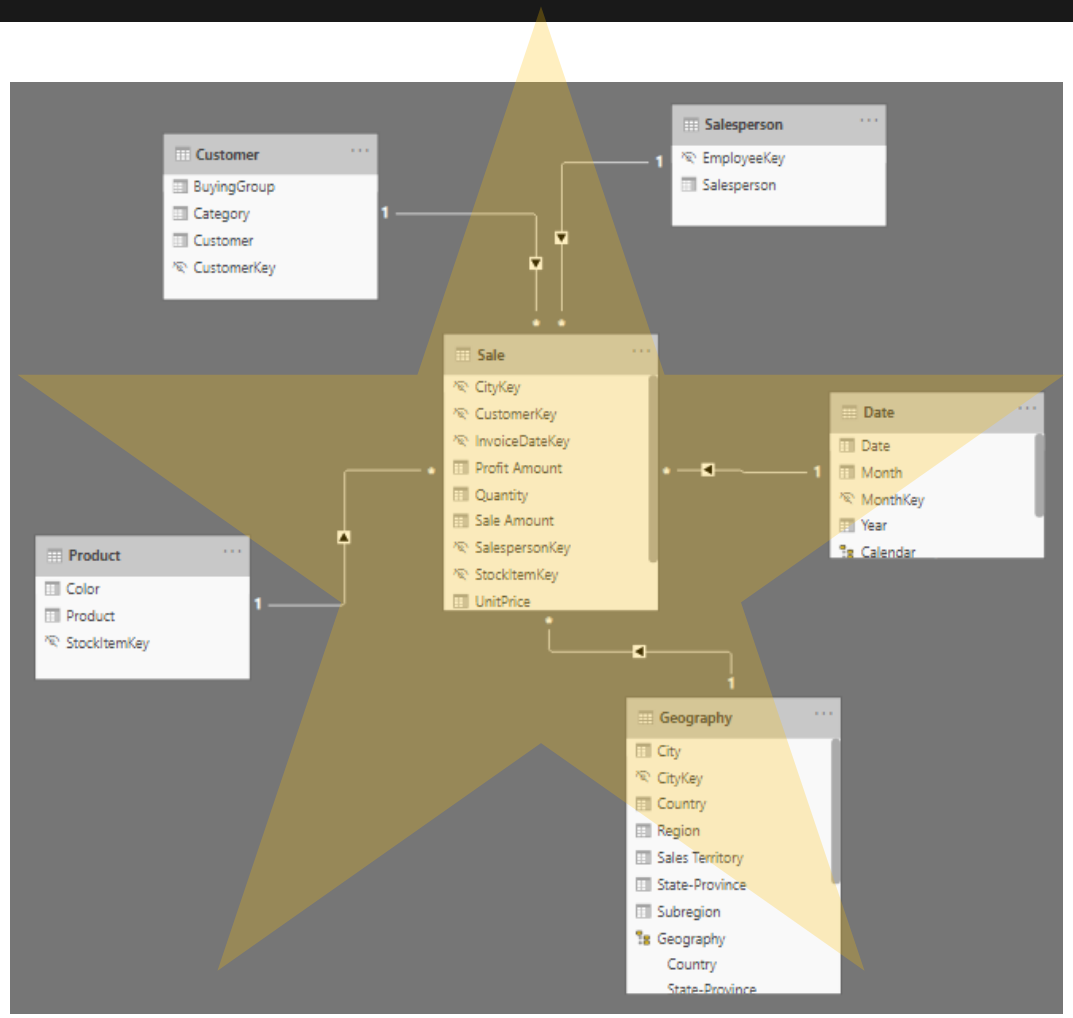
Power BI data modeling

Model basics » Star schema



Power BI data modeling

Model basics » Star schema



Power BI data modeling

Model basics

- Well designed tables and relationships are the model foundations
  - Power Query is the technology used to create model tables
- Upon the foundations, modelers can:
  - Enhance column properties with default summarization, data categorization, sorting, or formatting
  - Add hierarchies to support drill down/up
  - Add calculations to create new tables, columns, or measures, which summarize model data
  - Organize model fields into display folders
  - Add roles to enforce row-level security (RLS) for different report user audiences

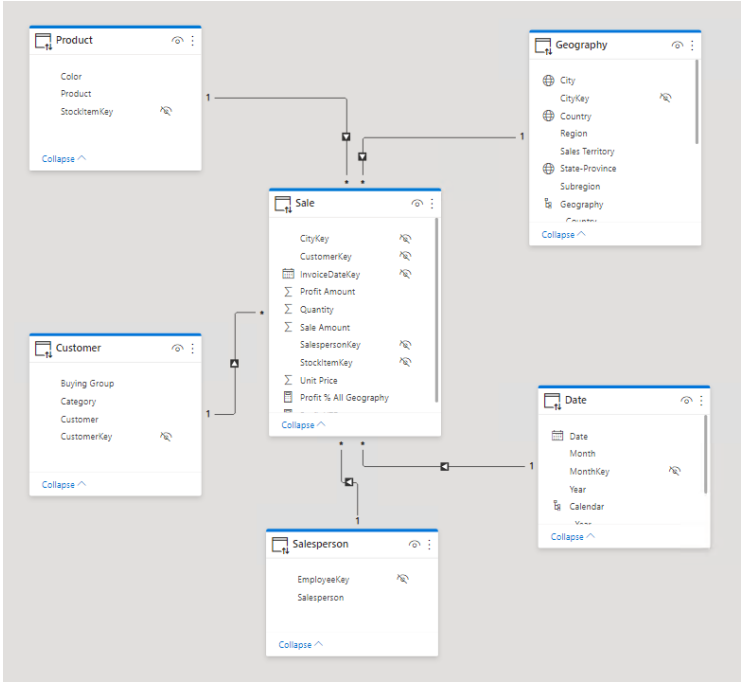
Power BI data modeling

Model basics » From source to visualization

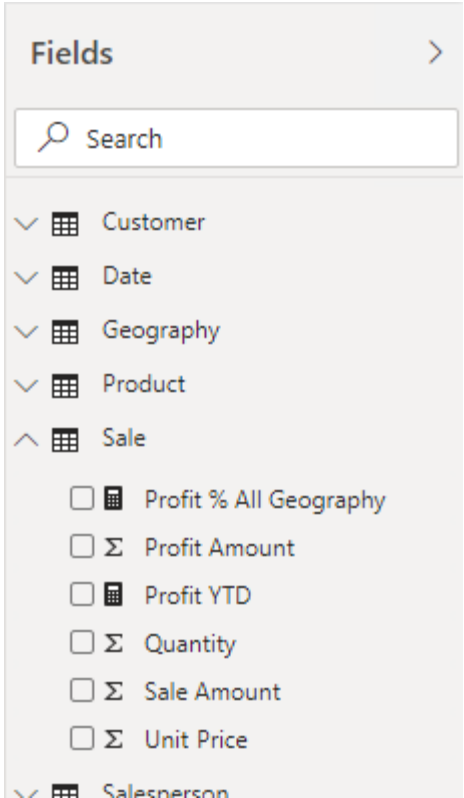
Source | Model | Visualization

Azure Synapse Analytics

Modeler view



Report author view



Power BI data modeling

Storage modes

- Each model table has a storage mode:
  - Import (Vertipaq)
  - DirectQuery
  - Dual—both Import and DirectQuery
- Possible model frameworks:

Table storage	Model framework
All tables are **Import** storage mode	Import
All tables are **DirectQuery** storage mode	DirectQuery
Model has **Mixed** storage mode	Composite

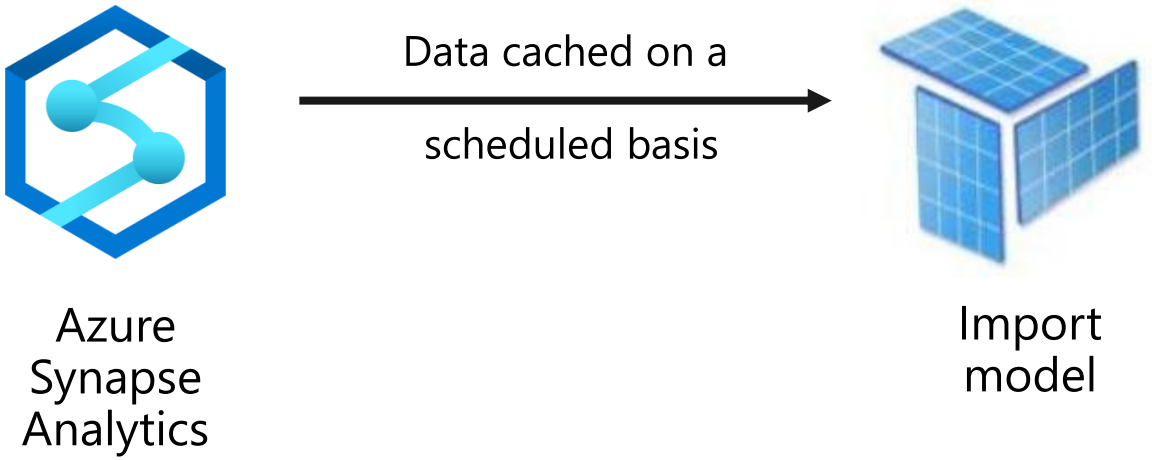
Power BI data modeling

Model framework » Import

- **Import storage mode** caches table data in compressed and optimized column stores
- Generally, it provides the fastest query performance
  - But—requires periodic data refresh to keep data current

Power BI data modeling

Model framework » Import



Power BI data modeling

Model framework » Import

- Develop an Import model when:
  - The entire model fits into available memory
  - Data latency between data refreshes can be tolerated
  - Power Query transformations are complex
  - Model calculations are complex
- Because data warehouses represent large volumes of data, usually an Import model can only be considered when:
  - Caching high level summarizations
  - Caching only recent history

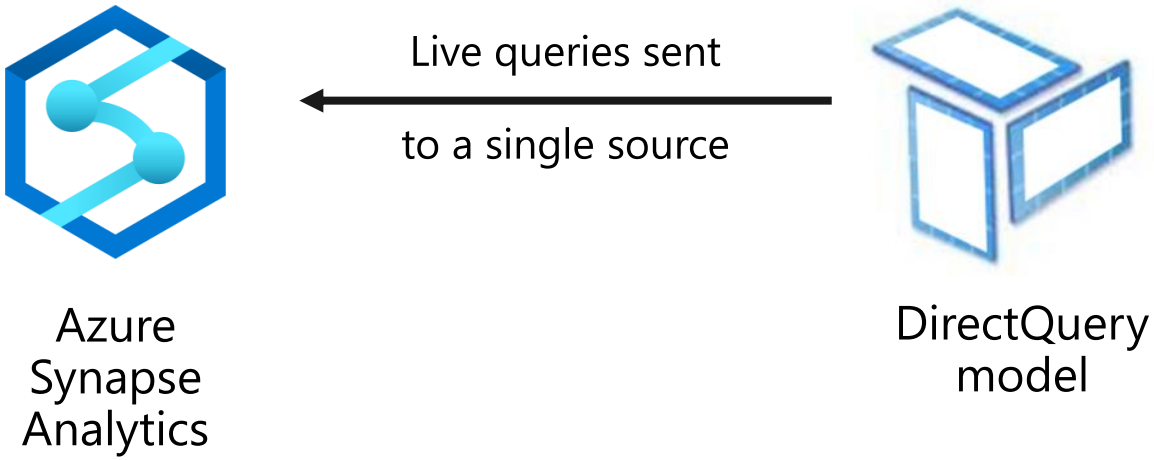
Power BI data modeling

Model framework » DirectQuery

- **DirectQuery storage mode** is an alternative to Import storage mode
- When queried, a DirectQuery table uses native queries to retrieve data from an underlying data source
- Generally, it allows:
  - Creating tables over large data volumes
  - Achieving near real-time reporting

Power BI data modeling

Model framework » DirectQuery



Power BI data modeling

Model framework » DirectQuery

- Develop a DirectQuery model when:
  - Data volume cannot fit into memory
  - Data latency must be low
  - Power Query transformations are simple
  - Model calculations are simple
- This model mode is well-suited for data warehouses
  - The model can query all data
  - Reports display the latest data

Exercise 06

45 minutes

Develop a Power BI Model

You must use the lab Azure credentials to connect to Azure Synapse and publish to Power BI

- Section 1: Create the Model
- Section 2: Develop the Model
- Section 3: Test the Model

Power BI data modeling

Model framework » Composite

- A Composite model combines storage modes
  - Some tables use Import storage
  - Some tables use DirectQuery storage
  - Some tables can be Dual storage (both modes)
- Generally, it provides the best of both worlds in a single model:
  - High performance for cached data (Import)
  - Analytics over large volumes of data (DirectQuery)
  - Near real-time reporting over source data systems (DirectQuery)
  - Accelerated performance over DirectQuery sources (aggregations)

Power BI data modeling

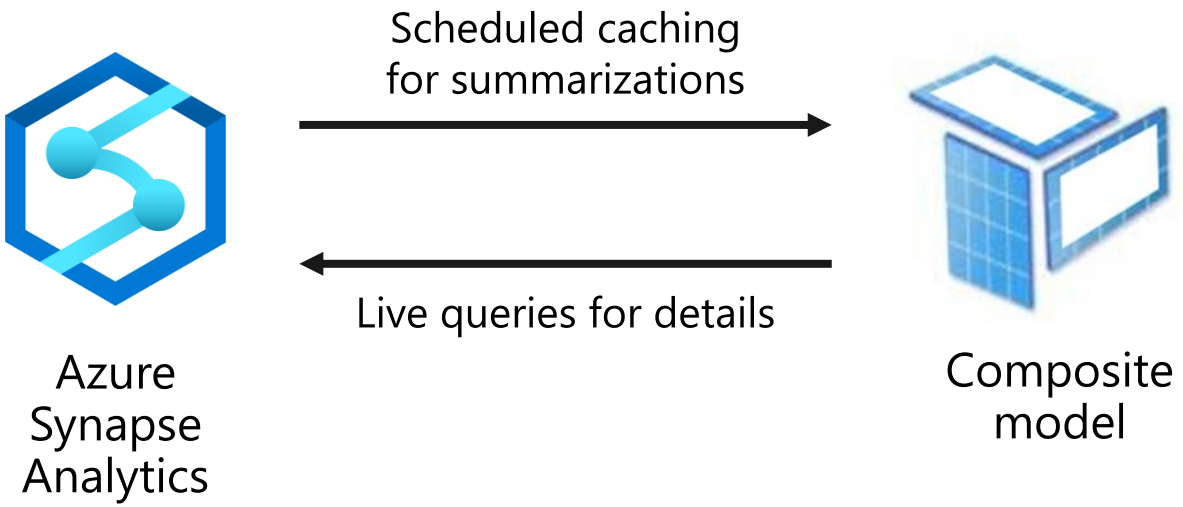
Storage framework » Composite » Scenarios

- Composite model designs fit three scenarios:
  - Integration of multiple sources
  - Accelerated performance over a single, large volume data source by using aggregations
    - Fast for summarized results
    - Slower for details
  - Creating a local model combining an existing Power BI dataset with additional imported data
    - It can be achieved by using DirectQuery to connect to a Power BI dataset

DirectQuery to Power BI datasets will be covered in Section 03

Power BI data modeling

Storage framework » Composite with aggregations



Power BI data modeling

Aggregations

- Aggregations are special model tables that are designed to accelerate model query performance
- Use aggregations to:
  - Accelerate query performance over large data stores
  - Optimize data refresh
  - Balance frameworks, allowing a model to strike the right balance of technologies to meet query demands

Power BI data modeling

Aggregations

- Aggregations can use Import or DirectQuery storage mode
  - Import requires a periodic refresh of source data
  - DirectQuery can query optimized summary data (materialized views)
- Note: Aggregations are hidden from report users
  - It is not possible to write model queries to use aggregations
  - Power BI automatically redirect queries to the aggregation whenever possible

Power BI data modeling

Capacities

- Power BI capacities support workloads (query, refresh, etc.)
- They are either:
  - Shared
  - Dedicated

Power BI data modeling

Capacities » Shared

- **Shared capacity** workloads run on computational resources shared with other customers
- Reduced feature set with stricter limitations:
  - Maximum 1 GB model size
  - Maximum 8 dataset refreshes per day
  - Recipients of shared content require **Power BI Pro** licenses
- Not recommended for enterprise deployments

Power BI data modeling

Capacities » Dedicated

- **Dedicated capacity** workloads run on hardware reserved for use by an organization
- Supports greater scale:
  - Larger in-memory datasets
  - More DirectQuery query throughput
  - More model refreshes in parallel
  - Maximum 48 dataset refreshes per day
- Includes capacity metrics app to monitor comprehensive metrics
  - See: https://docs.microsoft.com/power-bi/admin/service-admin-premium-monitor-portal

Power BI data modeling

Capacities » Dedicated » Licensing

- Allows sharing content with **Power BI Free** users
- Supports Power BI paginated reports
- Includes license for Power BI Report Server (on-premises reporting)
- Supports advanced features including AI capabilities
- Available with:
  - Power BI Premium (SKUs: EM1-EM3, P1-P3)
  - Azure (SKUs: A1-A6)
- **Power BI Premium** is recommended for enterprise deployments

Power BI data modeling

Capacities » Dedicated » Licensing » Node types

Node type	Virtual cores	FE/BE cores	Memory (GB)	DQ/LC (per sec)	Refresh parallelism
EM1/A1	1 *	.5/.5 *	2.5	3.75	1
EM2/A2	2 *	1/1 *	5	7.5	2
EM3/A3	4	2/2	10	15	3
P1/A4	8	4/4	25	30	6
P2/A5	16	8/8	50	60	12
P3/A6	32	16/16	100	120	24

* Front-end and back-end cores for A1 and A2 SKUs use shared resources

Exercise 07

15 minutes

Optimize the Power BI Model

You must successfully complete **Exercise 06** before commencing this exercise

- Section 1: Add an Aggregation Table
- Section 2: Publish the Model

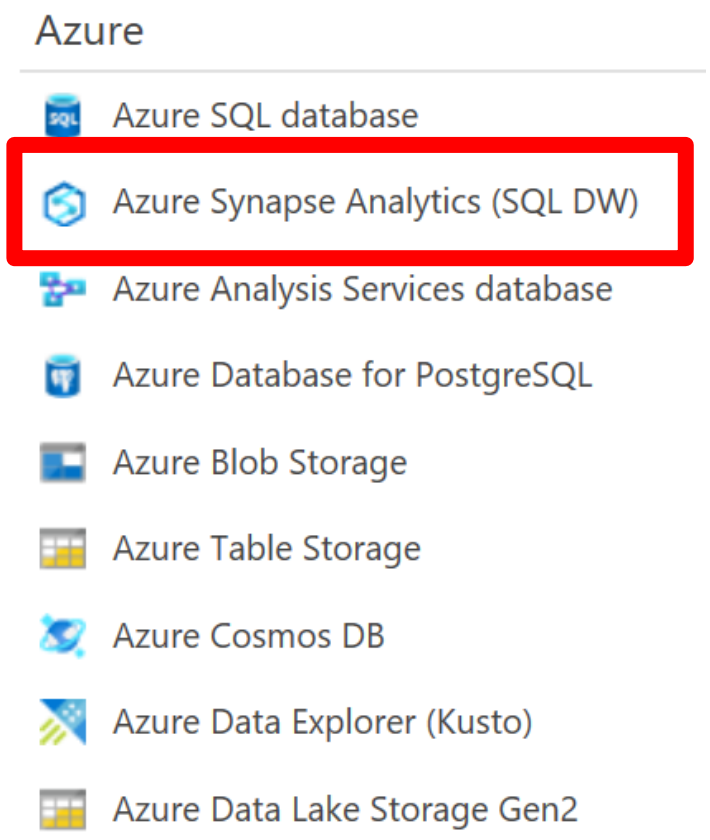
Developing models

General methodology

1. Connect to Synapse SQL pool
2. Design Power Query queries and configure table storage mode
3. Design aggregations
4. Enforce data permissions
5. Configure data refresh
6. Endorse dataset
7. Secure dataset
8. Optimize Power Query native queries to deliver improved performance
9. Optimize Synapse SQL pool to deliver improved performance

Developing models

1: Connect to Synapse SQL pool



- Two options:
  - Download a .pbids (Power BI Desktop Source) file from Synapse Studio
  - Or, connect directly using the Power BI Desktop **Azure Synapse Analytics (SQL DW)** connector

Developing models

2: Design queries and configure table storage mode

- Consider developing either a DirectQuery or Composite model
  - Large data stores cannot be entirely cached in memory—unless only high-level data is imported
- Generally, fact tables are suited to DirectQuery storage mode
- Generally, dimension tables are suited to Dual storage mode
  - When only the Dual table is queried (for example, by a slicer visual), Power BI will use the cached data
  - When a query needs to join dimension and fact tables, Power BI will use DirectQuery

Developing models

2: Design queries and configure table storage mode (Continued)

- Avoid complex Power Query logic that does not completely fold
  - Query folding is the consolidation of Power Query steps into a native database statement
- Configure model relationships to “assume referential integrity” when it is guaranteed that integrity is in place
  - When joining tables, Power BI will use INNER joins instead of OUTER joins
- Avoid bi-directional model relationships
  - They can negatively impact query performance

Developing models

3: Design aggregations

- To accelerate high-grain fact table queries, create aggregations
  - They are only supported over DirectQuery model tables
- Aggregations can be designed for a specific dimensionality and column summarizations
  - Basic rule: Aggregation row count should be at least a factor of 10 smaller than the underlying table
- Storage mode can be either Import or DirectQuery
  - DirectQuery is suitable when materialized views provide the performance boost

Developing models

4: Enforce data permissions

- RLS can be enforced by the Power BI model and/or Azure Synapse Analytics
- If there is a reason to enforce RLS in Azure Synapse Analytics (to ensure consistent data access by other reporting tools), it could be better to allow Power BI to pass through the report user identity
  - Pass report user identity by enabling Single Sign-On (SSO)
    - When SSO is enabled, Import aggregations are not used
  - However for performance reasons, it could be more efficient to duplicate RLS rules in the Power BI model

Developing models

5: Configure data refresh

- If the Power BI model has any Import and Dual tables, consider how and when caches update
  - When using Dual storage or Import aggregations, when caches are old, Power BI visuals can produce inconsistent results
- Power BI Premium supports up to 48 scheduled data refreshes a day
- Other options:
  - Use Azure Data Factory to trigger a refresh by using the Power BI REST API
    - This way, trigger the refresh after data pipelines have successful completed
  - Use the XMLA endpoint for fine-grain data refresh

Developing models

6: Endorse datasets

- Datasets can be endorsed so others can easily discover them and trust them
  - Dataset owners can **promote** a dataset to communicate it is ready for wide-spread use
  - Authorized users can **certify** a dataset to communicate reliable and high-quality data
- It is recommended that enterprise BI models be certified

Developing models

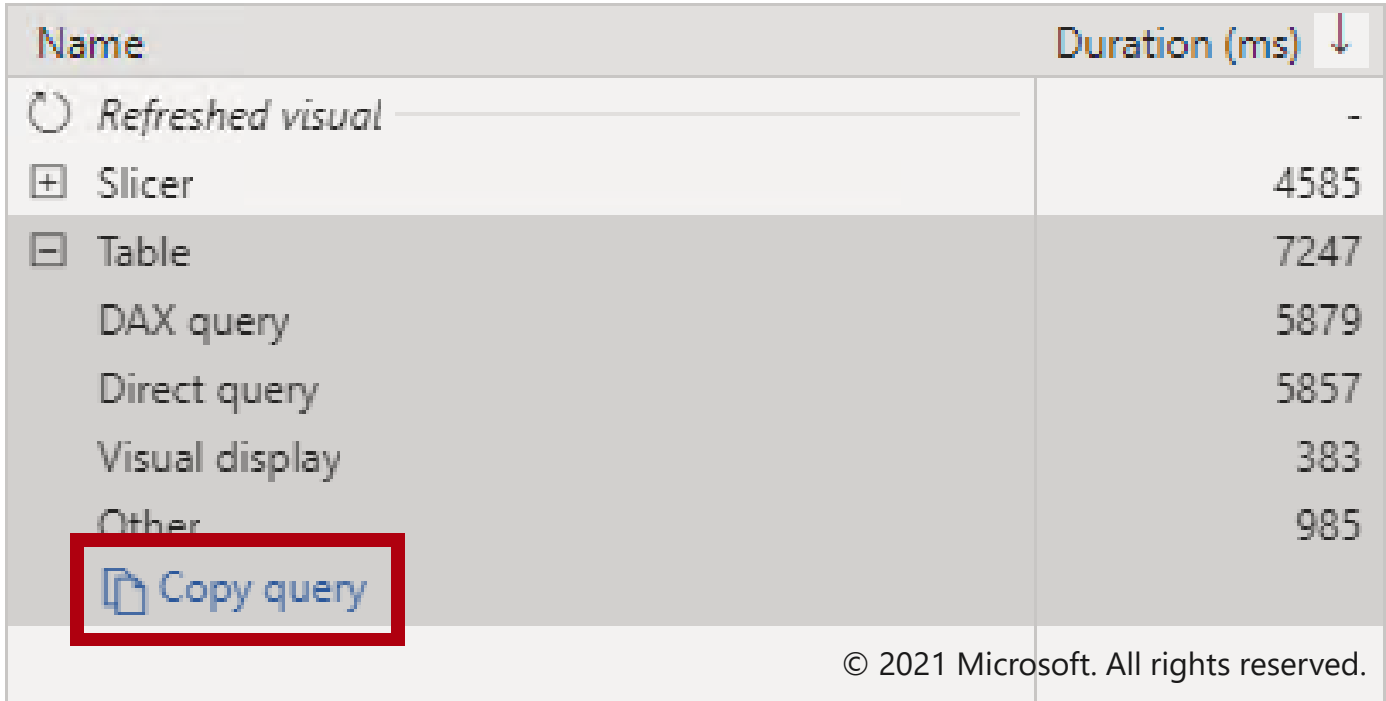
7: Secure and publish datasets

- When the Power BI model is published, the dataset must be made available to report users and report authors
  - **Read** permission allows viewing content and export data
  - **Build** permission allows discovering and reusing the dataset
- It is recommended that you grant permissions to Azure AD groups representing your different audiences (users or authors)
- Also, if RLS is enforced, map Azure AD groups to roles

Developing models

8: Optimize Power Query queries

- Test query performance by using Power BI Desktop **Performance Analyzer**
  - Reports duration statics for each visual
  - Allows copying the native query sent to the data source



Developing models

9: Optimize Synapse SQL pool

- Maintain statistics
- Use DMVs to monitor and optimize your queries
- Tune query performance with new product enhancements
  - Materialized views
  - Ordered clustered columnstore indexes
  - Result set caching
- Hash distribute large tables
- Do not over-partition
- Optimize clustered columnstore tables
- Use smaller resource classes to increase concurrency
- Ensure data integrity is in place, with matching values for all joins

Key takeaways

- Power BI models can be designed to scale over large data stores
- High performance Power BI models can depend on:
  - Capacity scale of **Power BI Premium**
  - Mixed model table storage modes (Composite model)
  - Model aggregations
  - Power BI report optimizations
- Synapse SQL pool can be optimized to deliver the best possible query performance based on how Power BI queries it

Resources

Power BI enterprise deployment whitepaper

Covers key considerations, the decisions which will be necessary throughout the process, and potential issues you may encounter. Best practices and suggestions are offered when possible.

https://docs.microsoft.com/power-bi/guidance/whitepaper-powerbi-enterprise-deployment

Power BI Premium deployment articles

https://docs.microsoft.com/power-bi/guidance/whitepaper-powerbi-premium-deployment

Best practices for Synapse SQL pool in Azure Synapse Analytics

https://docs.microsoft.com/azure/synapse-analytics/sql-data-warehouse/sql-data-warehouse-best-practices

DirectQuery model guidance in Power BI Desktop

https://docs.microsoft.com/power-bi/guidance/directquery-model-guidance

Resources

Videos

Microsoft Ignite 2019

Microsoft Power BI and Azure Synapse Analytics: Intelligent action over big data
https://myignite.techcommunity.microsoft.com/sessions/84568

Microsoft Business Applications Summit 2020

Modern Enterprise BI
https://community.powerbi.com/t5/MBAS-Gallery-2020/Modern-Enterprise-BI/td-p/1078414

Resources

Blog announcement

Announcing Azure Synapse Analytics public preview

Arun Ulag - Corporate Vice President, Power BI

Stay tuned for new enhancements that will make end-to-end direct querying experience over big data highly performant

https://powerbi.microsoft.com/blog/announcing-azure-synapse-analytics-public-preview

Questions?

Microsoft

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Section 03

Deliver Flexibility at the Edge

Section outline

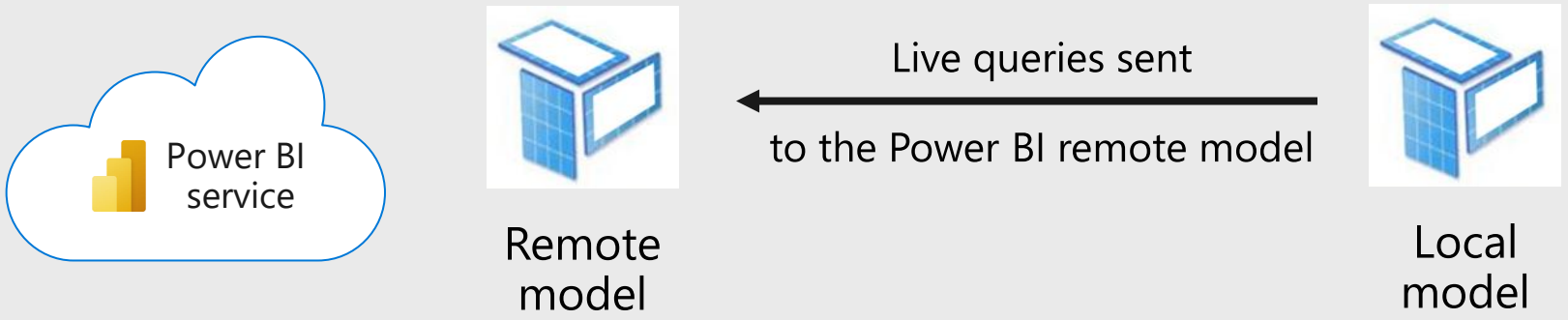
03: Deliver Flexibility at the Edge

- Create models using DQ to Power BI
- Best practice guidance

Create models using DQ to Power BI

- DirectQuery (DQ) connections can now be made to Power BI datasets and Azure Analysis Services (AAS)
  - The new model is referred to as the “local model”
  - The source model is referred to as the “remote model”

It is a preview feature, now available in Power BI Desktop, December 2020 release



Create models using DQ to Power BI

Scenarios

- Creating models using DQ to Power BI will likely appeal to data analysts, allowing them to:
  - Personalize a remote model
  - Extend a remote model with:
    - New tables
    - Relationships
    - Calculations

Create models using DQ to Power BI

Scenario » Personalize a remote model

- A remote model can be personalized in many ways:
  - Modify any remote model object, *except*:
    - Table storage mode
    - Column data type
    - Calculation expression
    - Relationships, which cannot be removed or modified
  - Add new relationships
  - Add new calculated columns and groups
  - Add new measures *
  - Add new hierarchies

* Adding measures can also be achieved in a live connection

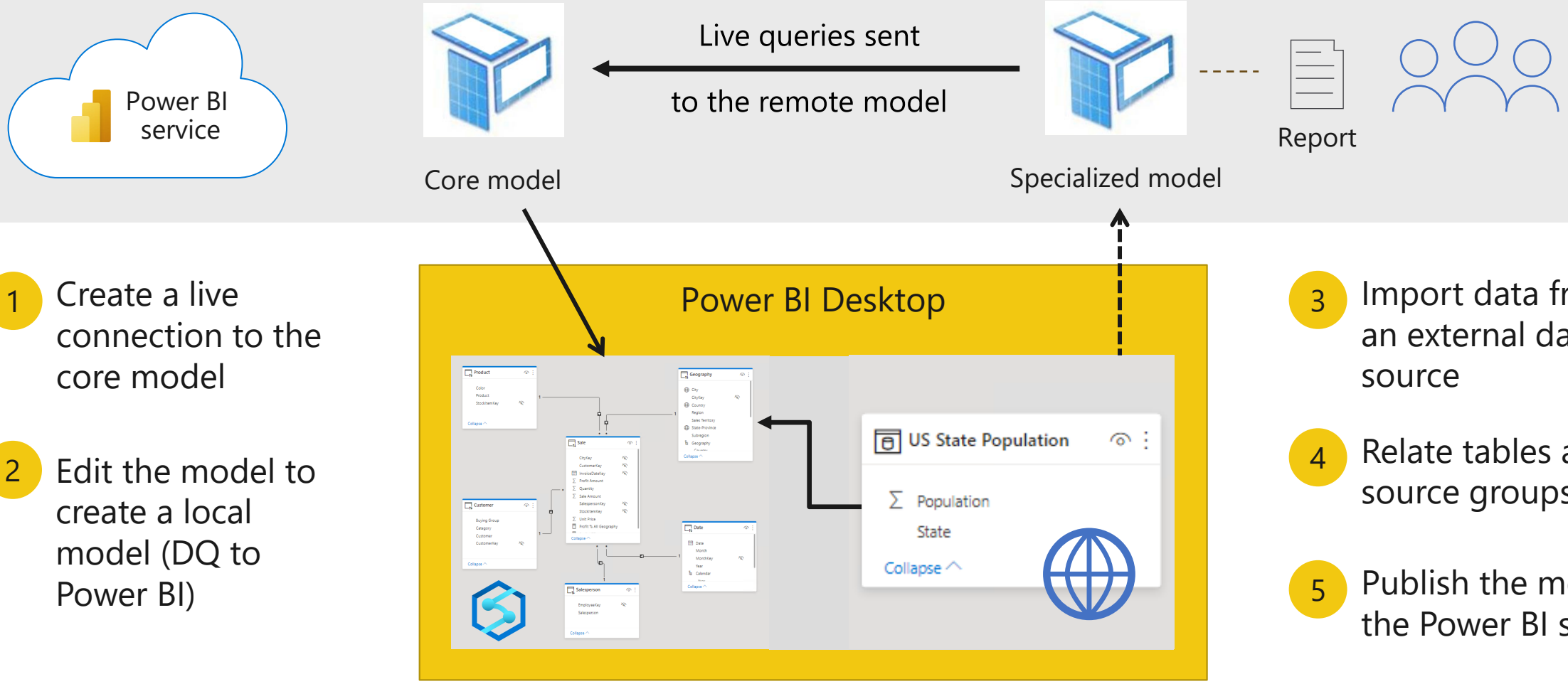
Create models using DQ to Power BI

Scenario » Extend a remote model

- Extend a remote model with new source groups:
  - Use the “enter data” to import static sets of data
  - Import data from external data sources
  - Add new DirectQuery source tables
- Possibilities:
  - Create relationships between tables from different source groups
  - Create measures that use columns from different source groups
  - Define RLS rules, but only on local tables

Create models using DQ to Power BI

Example



1. Create a live connection to the core model
2. Edit the model to create a local model (DQ to Power BI)
3. Import data from an external data source
4. Relate tables across source groups
5. Publish the model to the Power BI service

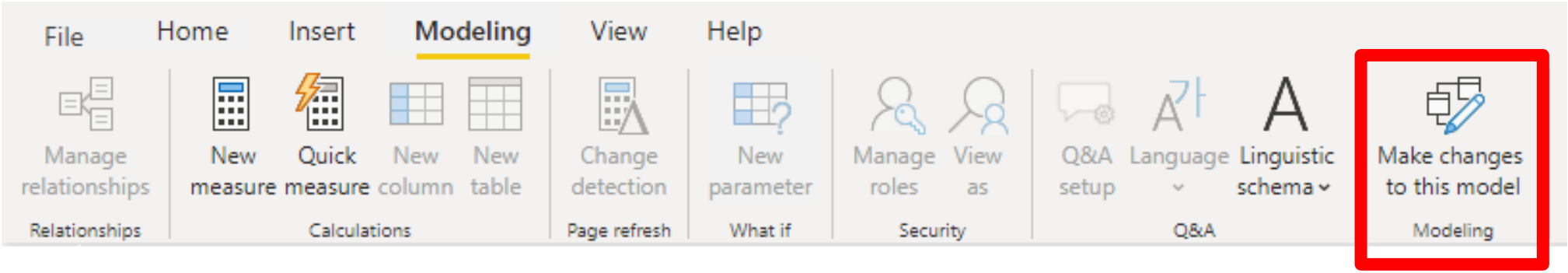
Create models using DQ to Power BI

General methodology

1. In Power BI Desktop, create a live connection to a Power BI dataset
2. Create a local model (DQ to Power BI) by “editing” it
3. Modify model properties to suit
4. Optionally, add new tables using import or DirectQuery connections
5. Publish the model to the Power BI service
6. Apply data source credentials (if additional tables were added)

Create models using DQ to Power BI

Edit the model



- A live connection can be “edited”
- It replaces the live connection with a local DirectQuery model
- Once replaced, it is not possible to revert to a live connection

Create models using DQ to Power BI

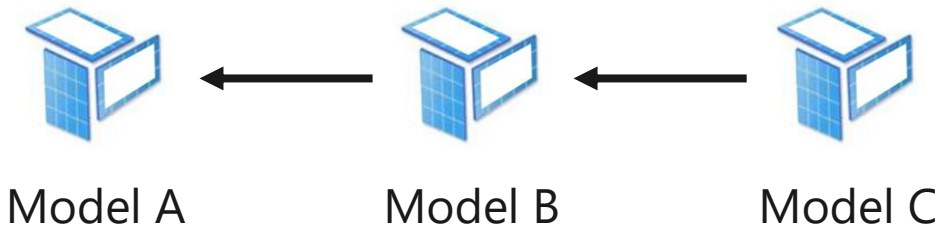
Manage models using DQ to Power BI

- When tables based on external data are added to a local model, data source credentials must be applied in the Power BI service
- Over time, remote model changes may be published
  - A data refresh of the model using DQ to Power BI will sync changes
    - Any name conflicts are automatically resolved
  - Some changes may result in breaking the model using DQ to Power BI, and so will require revising the model design in Power BI Desktop and republishing it

Create models using DQ to Power BI

Chaining

- The term **chaining** describes the DirectQuery connections between models
  - A model (B) DirectQuery connection to the model (A) is one chain
  - A model (C) DirectQuery connection to model (B) is another chain, etc.



- It is not possible to extend beyond a chain length of three

Create models using DQ to Power BI

Limitations

- There are numerous limitations, some of which may be removed in later preview releases or by GA
  - DirectQuery connections to SQL Server Analysis Services (SSAS) are not supported
  - It is not possible to create a DirectQuery connection to a Power BI dataset in a personal workspace
  - It is not possible to extend beyond a chain length of three
  - RLS rules can only be applied on local model tables

The list of limitations will gradually be removed—be sure to check documentation often as the capability matures

Create models using DQ to Power BI

Limitations (continued)

- (Continued)
  - Format strings, display folders, KPIs, date tables, and translations are not currently imported from the remote model—however, many model object properties can be re-applied in the local model
  - Sort by column is not currently supported
  - Automatic page refresh (APR) is only supported for some scenarios, depending on the data source type
  - Power Query parameters for database and server names are currently disabled

Best practice guidance

- Best practice guidance applies to different roles:
  - BI developer
  - Data analyst
- Generally, BI developers should aim to publish core models that have the potential to be *specialized* by data analysts

Best practice guidance

BI developer

- Ideally, core data models should not use DirectQuery connections to other data models
  - There are fewer opportunities for Power BI to optimize query performance
- When it is known that data analysts are creating DirectQuery connections to the model, take care when publishing model changes
  - Certain model changes can break chained models—for example, renamed model objects, column data type changes, modified relationships, and calculation expressions
- Consider creating a feedback loop to ensure data analyst needs are met—potentially resulting in the addition of enhancements directly to the core model

Best practice guidance

Data analyst

- Creating a model using DQ to Power BI is a powerful concept, but it can introduce problems:
  - Change management issues
  - Performance issues
- Avoid excessive chaining, because it can be difficult to:
  - Manage change
  - Diagnose and solve performance issues

Best practice guidance

Data analyst (Continued)

- Only create a model using DQ to Power BI when there is a genuine need, so first consider:
  - Asking BI developers to extend the core “single version of the truth” model, if it makes sense to do so
  - Working instead with a live connection to the remote model, when
    - Only adding measures—it is already a supported capability for live connections
    - Only renaming model objects or creating hierarchies—you can do that when configuring report visuals
- Test report data carefully to ensure the model using DQ to Power BI produces correct results

Exercise 08

20 minutes

Create a Model Using DQ to Power BI

You must successfully complete **Exercise 07** before commencing this exercise

- Section 1: Get Started
- Section 2: Develop a Model Using DQ to Power BI

Key takeaways

- It is now possible to create DirectQuery connections to Power BI datasets
- It enables two new scenarios for the data analyst:
  - Personalization of a remote model
  - Extension of a remote model with new tables, relationships, or calculations

Resources

Using DirectQuery for Power BI datasets and Azure Analysis Services

https://docs.microsoft.com/power-bi/connect-data/desktop-directquery-datasets-azure-analysis-services

The list of limitations will gradually be removed—be sure to check the article often

Questions?

Microsoft

Analytics in a Day
Azure Synapse + Power BI better together

Section 04

Author Power BI Reports

Section outline

04: Author Power BI Reports

- Authoring reports
- Advanced design features
- Best practice guidance

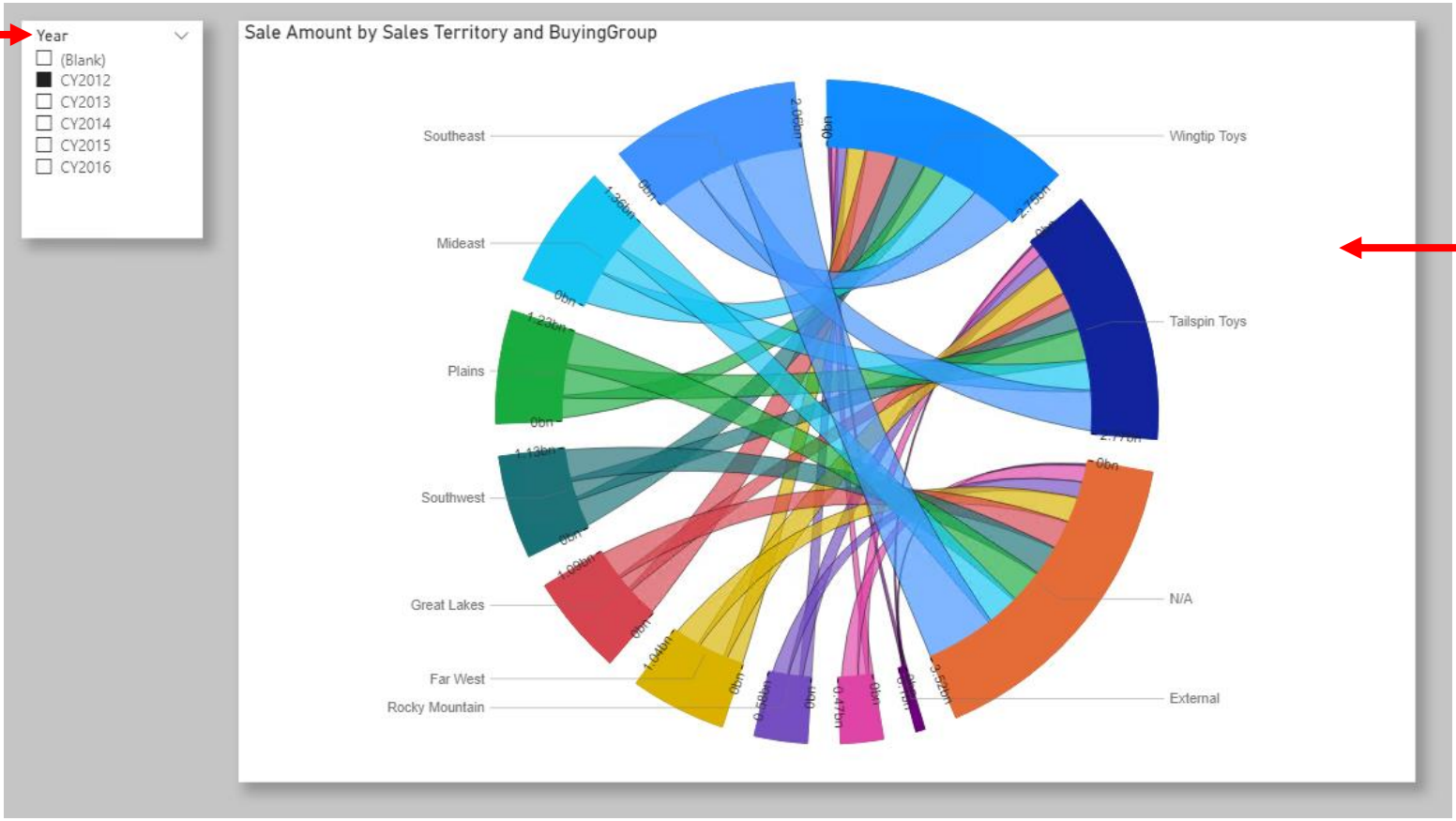
Authoring reports

- A Power BI report allows report users to interactively explore data to discover relationships and patterns
- It must be based on a single dataset
- It consists of one or more pages
- Each page contains elements:
  - Visuals
  - Slicers
  - Text boxes, images, shapes, or buttons

Authoring reports

Example

Slicer



Visual

Authoring reports

General methodology

1. Create a dataset connection
2. Add and configure report or page filters
3. Add and configure report elements (visuals/slicers/other objects)
4. Format elements
5. Optionally, create additional pages
6. Optionally, configure mobile view
7. Set initial state (first page, filter values, drill mode, sort order, etc.)
8. Save/publish

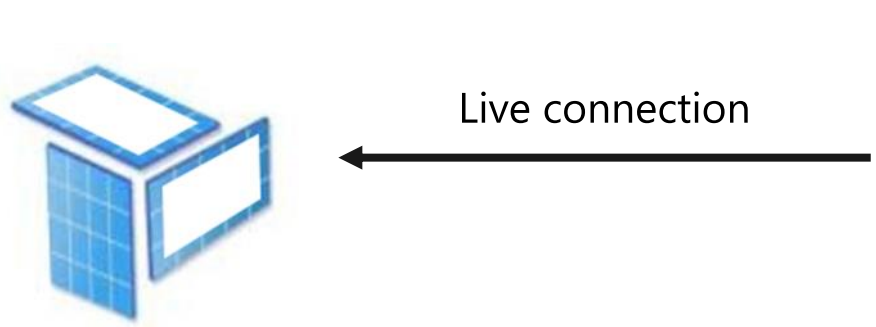
Authoring reports

1: Create a dataset connection

- Use a **Live Connection** to develop a report that directly queries a Power BI dataset
- Report authoring options:
  - Synapse Studio
  - Power BI service
  - Power BI Desktop
- All report authoring options are similar, except Power BI Desktop allows creating report-level measures

Authoring reports

1: Create a dataset connection » Live connection

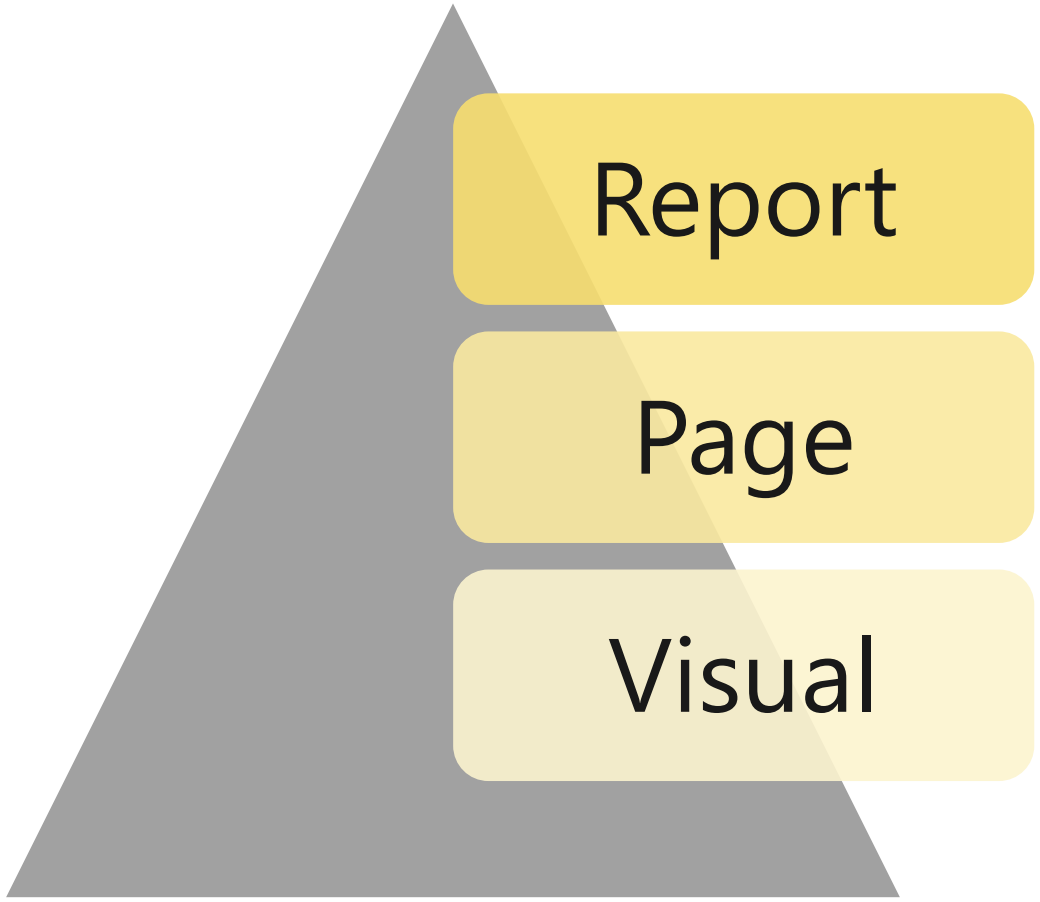


Model

- Synapse Studio
- Power BI service
- Power BI Desktop

Authoring reports

2: Add and configure report or page filters



- Filters can be scoped at three levels:
  - Report
  - Page
  - Visual
- Filters combine using AND, with each additional filtering adding further restrictions

Authoring reports

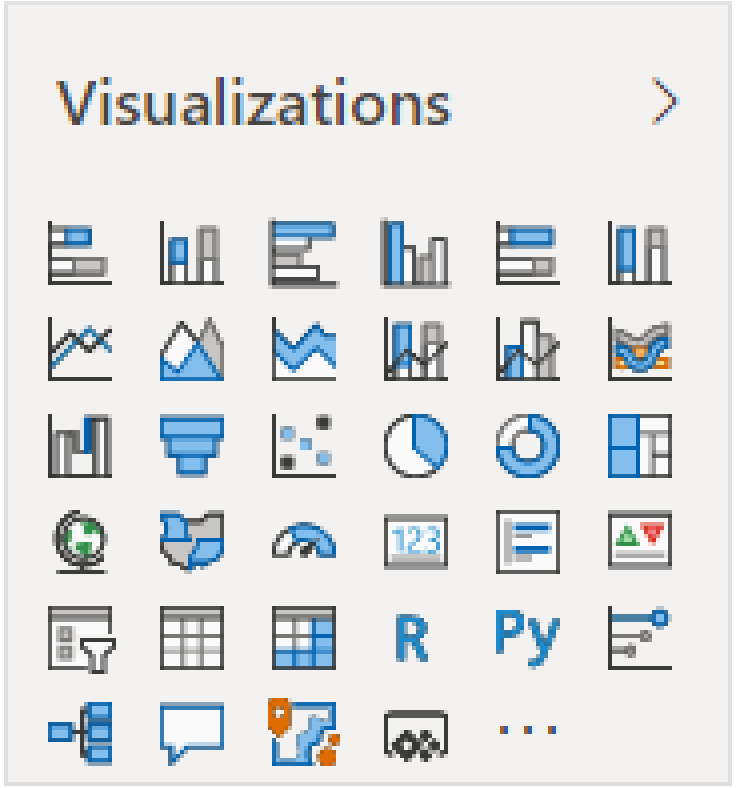
3: Add and configure report elements

- Report elements:
  - Visuals
  - Slicers for interactive filtering
  - Text boxes for rich text formatting
  - Images and shapes to add visual interest
  - Buttons to launch actions

Authoring reports

3: Add and configure elements » Visuals

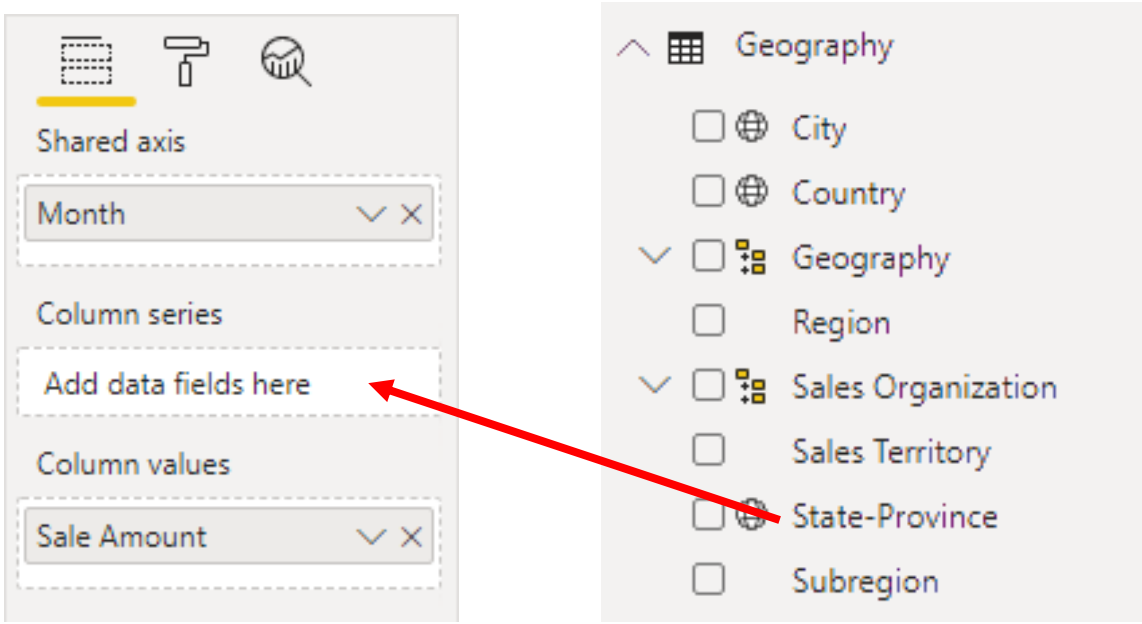
- Choose from numerous modern visual types:
  - Filter data:
    - Slicer
  - Display numeric values:
    - Card, Multi Row Card, Table, Matrix, KPI
  - Graphically visualize data:
    - Bar, Column, Line, Combo, Scatter, Waterfall, Pie, Donut, Funnel, Treemap, Gauge
  - Spatially visualize data:
    - Map, Filled map, Shape map
  - Import custom visuals
    - From file or Microsoft AppSource



Authoring reports

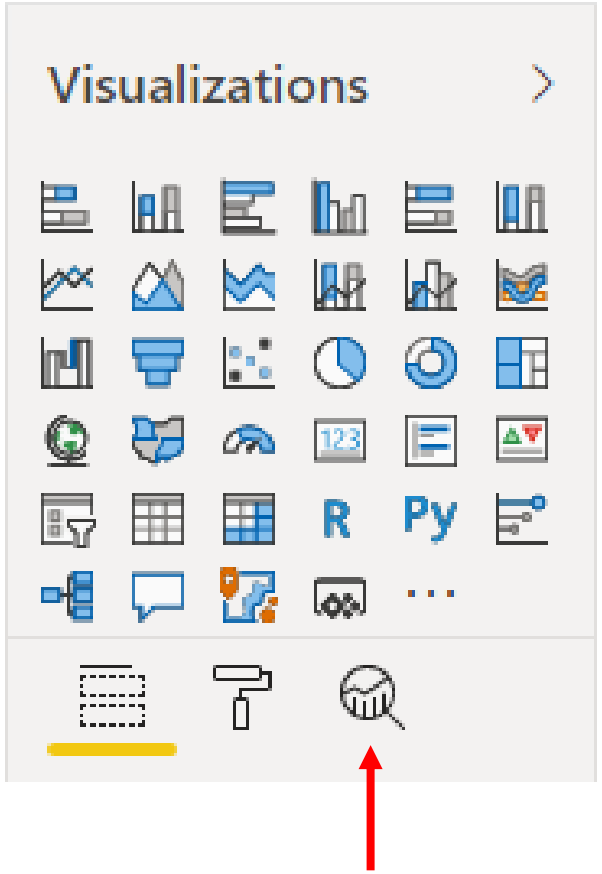
3: Add and configure elements » Visuals

- Use the visual **Fields** pane to configure the data settings for a visual
  - Do no confuse this pane with the report **Fields** pane
  - Add fields to appropriate wells
  - Configure fields:
    - Rename
    - Set aggregation function
    - Show items with no data
    - Reorder
    - Remove



Authoring reports

3: Add and configure elements » Visuals » Analytics

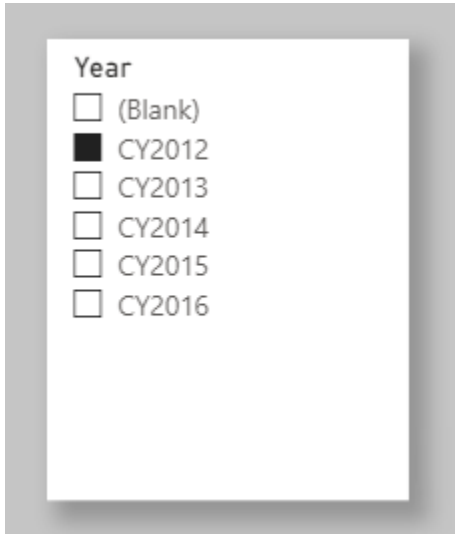


- Overlay analytic lines:
  - Trend
  - Constant
  - Min/max
  - Average
  - Median
  - Percentile
  - Forecast

Authoring reports

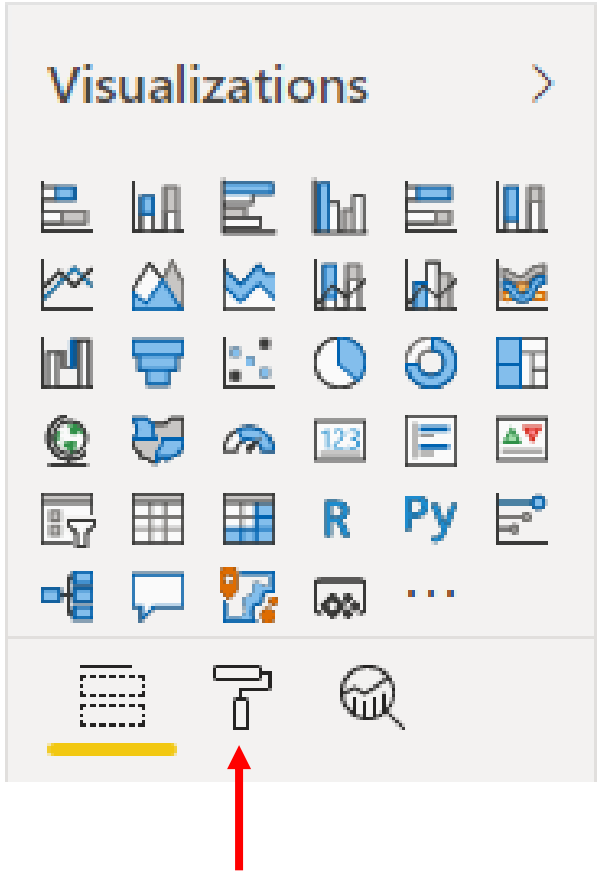
3: Add and configure elements » Visuals » Slicer

- Use slicers to enable users to interactively filter the page
  - Based on a single field or multiple fields (hierarchy)
- Different display options are supported by data type:
  - **Text**: Dropdown, list
  - **Number**: Slider range, dropdown, list
  - **Date**: Slider range, dropdown, list, relative time
- Dropdown and list styles can be formatted to:
  - Allow single-select or multi-select
  - Show an “All Items” option
- Slicers can be synchronized (synced) across pages



Authoring reports

4: Format elements



- Format the selected element
- For example:
  - Add titles
  - Add data labels
  - Set styles
  - Configure conditional formatting
  - And many other possibilities

Authoring reports

5: Create additional pages

- Report pages can be:
  - Created
  - Renamed
  - Deleted
  - Hidden
  - Re-sequenced
  - Duplicated

Authoring reports

6: Configure mobile layout

- Create an additional view that is optimized for mobile devices and displays in portrait orientation
  - Select and rearrange just the visuals that make sense for mobile users on the go

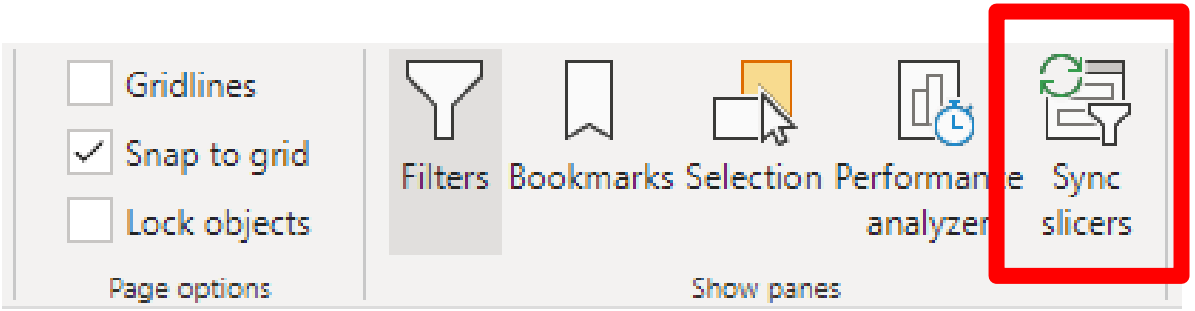
Advanced design features

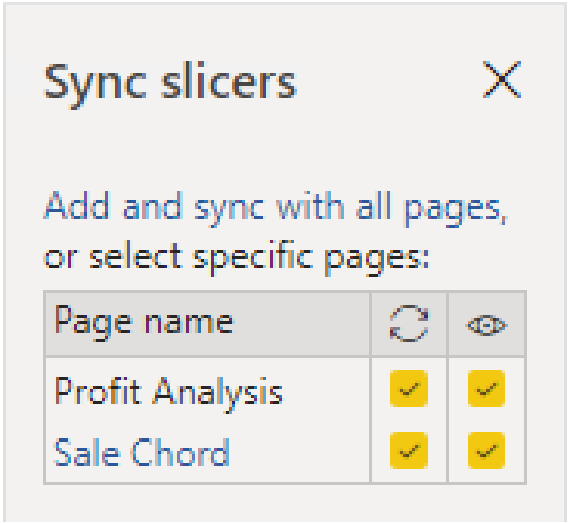
- Sync slicers
- Drill through pages
- Custom tooltips
- Bookmarks

Advanced design features

Sync slicers

- Use the **Sync Slicers** pane to determine for a selected slicer:
  - Which pages to sync
  - Whether to display the slicer
- All slicer interactions are synced to provide cross-page slicing

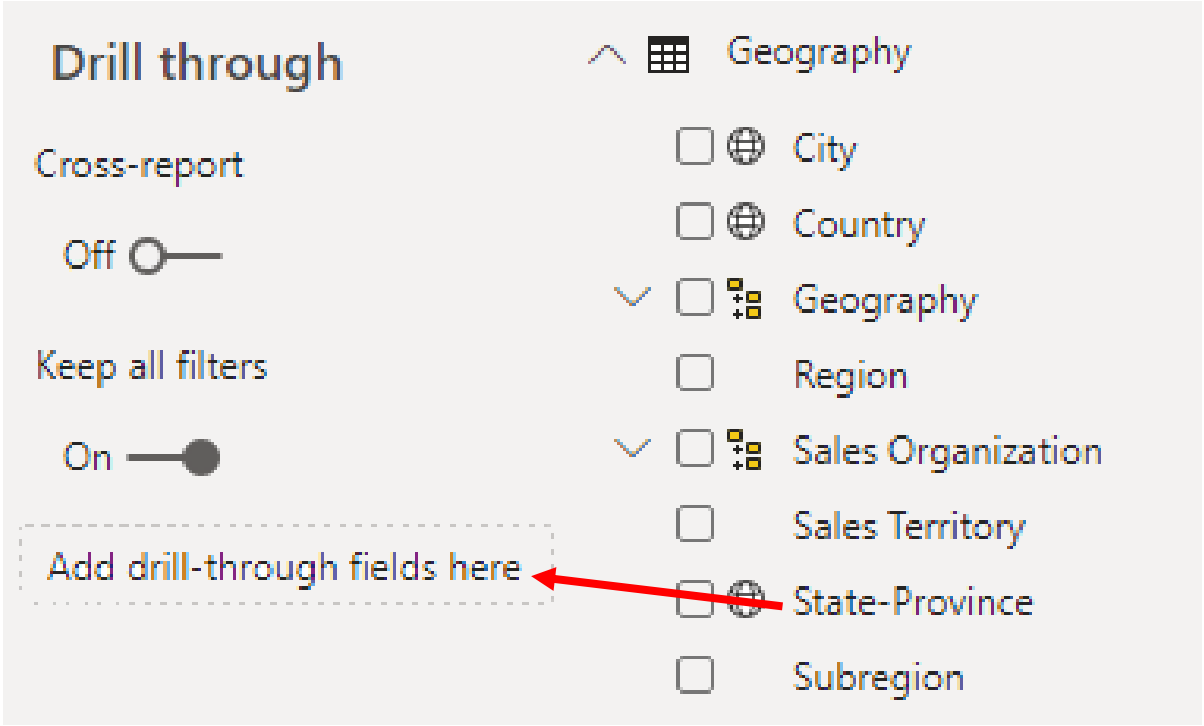




Advanced design features

Drill through pages

- Create drill through pages to present more detailed content
  - Set the drill through page to filter by a field
  - Report users can drill through from any visual that groups by that field
  - A back button is automatically added to the drill through page



Advanced design features

Custom tooltips

- Tooltips can be configured by adding fields to the **Tooltips** well of many visuals
- Report page tooltips can be created to display visuals in a tooltip
  - This design feature can achieve a similar result to a drill through page
- Tooltips can also be disabled for specific visuals

Advanced design features

Bookmarks

- Use the **Bookmarks** pane at design–time to capture the currently configured view of a report page
- Uses:
  - Create an ordered list of bookmarks, then click View to replay them as a story
  - Create advanced report interaction by assigning bookmarks to buttons and images
  - Select a bookmark to return to a previously captured state
- Report users can:
  - Open the pane at view-time
  - Can create personal bookmarks

Exercise 09

45 minutes

Author a Power BI Report

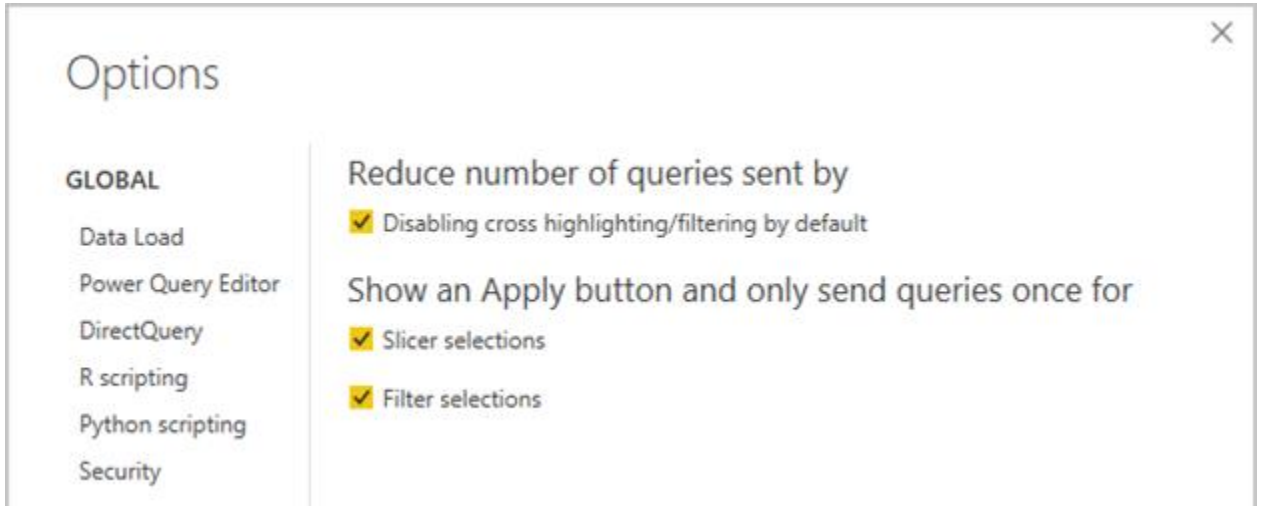
You must successfully complete **Exercise 07** before commencing this exercise

- Section 1: Develop the Report Layout
- Section 2: Develop a Drill Through Page
- Section 3: Work with Bookmarks
- Section 4: Publish the Report
- Section 5: Install the Gateway (Optional)

Best practice guidance

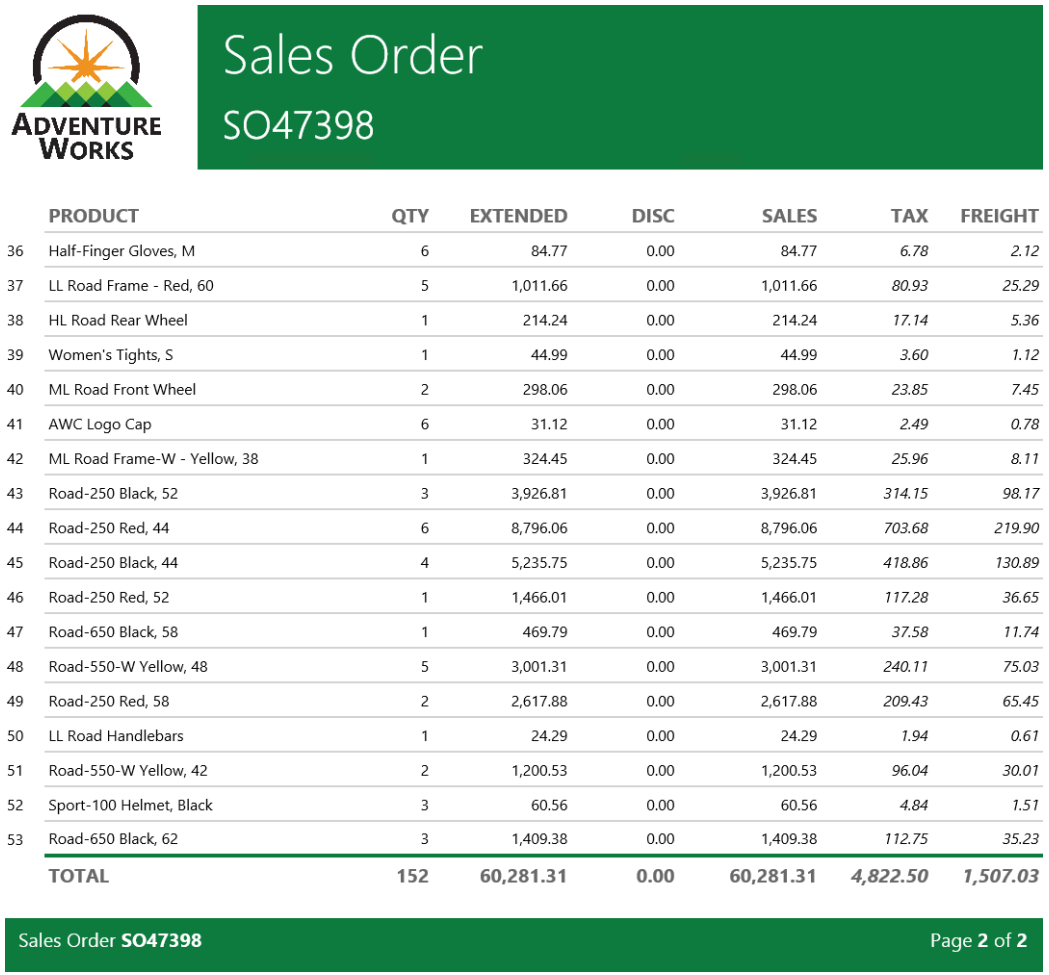
Optimize reports

- To improve report responsiveness in DirectQuery models:
  - Limit the number of visuals on a report page—use drill through pages for detail
  - Switch off interactions between visuals (cross highlight or filter)
  - Enable options to reduce the number of queries sent by:
    - Disabling cross highlighting/filtering by default
    - Adding an **Apply** button to slicers or filters



Best practice guidance

Optimize reports (Continued)



ADVENTURE WORKS

Sales Order

SO47398

	PRODUCT	QTY	EXTENDED	DISC	SALES	TAX	FREIGHT
36	Half-Finger Gloves, M	6	84.77	0.00	84.77	*6.78*	*2.12*
37	LL Road Frame - Red, 60	5	1,011.66	0.00	1,011.66	*80.93*	*25.29*
38	HL Road Rear Wheel	1	214.24	0.00	214.24	*17.14*	*5.36*
39	Women's Tights, S	1	44.99	0.00	44.99	*3.60*	*1.12*
40	ML Road Front Wheel	2	298.06	0.00	298.06	*23.85*	*7.45*
41	AWC Logo Cap	6	31.12	0.00	31.12	*2.49*	*0.78*
42	ML Road Frame-W - Yellow, 38	1	324.45	0.00	324.45	*25.96*	*8.11*
43	Road-250 Black, 52	3	3,926.81	0.00	3,926.81	*314.15*	*98.17*
44	Road-250 Red, 44	6	8,796.06	0.00	8,796.06	*703.68*	*219.90*
45	Road-250 Black, 44	4	5,235.75	0.00	5,235.75	*418.86*	*130.89*
46	Road-250 Red, 52	1	1,466.01	0.00	1,466.01	*117.28*	*36.65*
47	Road-650 Black, 58	1	469.79	0.00	469.79	*37.58*	*11.74*
48	Road-550-W Yellow, 48	5	3,001.31	0.00	3,001.31	*240.11*	*75.03*
49	Road-250 Red, 58	2	2,617.88	0.00	2,617.88	*209.43*	*65.45*
50	LL Road Handlebars	1	24.29	0.00	24.29	*1.94*	*0.61*
51	Road-550-W Yellow, 42	2	1,200.53	0.00	1,200.53	*96.04*	*30.01*
52	Sport-100 Helmet, Black	3	60.56	0.00	60.56	*4.84*	*1.51*
53	Road-650 Black, 62	3	1,409.38	0.00	1,409.38	*112.75*	*35.23*
	TOTAL	**152**	**60,281.31**	**0.00**	**60,281.31**	***4,822.50***	***1,507.03***

Sales Order **SO47398** Page **2** of **2**

- Consider using **Power BI paginated reports**, which can query Azure Synapse Analytics directly
  - No need to develop a Power BI dataset
  - Suited to print-ready, pixel-perfect report layouts
  - Also, they are a good choice when the report needs row-level details

Key takeaways

- Power BI reports deliver interactive experiences to report users
- Report designs can include advanced features
  - Drill through, sync slicers, custom tooltips, bookmarks
- High performance Power BI reports can depend on:
  - An optimized model
  - Applying restrictive filters
  - Limiting the number of visuals on each report page
  - Enabling data reduction features
- Paginated reports are suited to print-ready, pixel-perfect report layouts

Resources

Create reports and dashboards in Power BI
https://docs.microsoft.com/power-bi/create-reports/

Set up drill through in Power BI reports
https://docs.microsoft.com/power-bi/create-reports/desktop-drillthrough

Customize tooltips in Power BI Desktop
https://docs.microsoft.com/power-bi/create-reports/desktop-custom-tooltips

Create bookmarks in Power BI Desktop to share insights and build stories
https://docs.microsoft.com/power-bi/create-reports/desktop-bookmarks

Resources

Courses

Dashboard in a Day

https://aka.ms/nextDIAD

Paginated Reports in a Day

https://aka.ms/PRIADevent

Video course and self-study kit

https://aka.ms/priad-online-course

Use DAX in Power BI Desktop

Microsoft learning path, comprising seven modules

https://aka.ms/learndax

Questions?